Superfund Research Program

The Superfund Research Program (SRP) supports practical research that creates benefits, such as lower environmental cleanup costs and reduced risk of exposure to hazardous substances, to improve human health. SRP funds colleges, universities, and small businesses, including the Columbia University Superfund Research Center (Columbia SRC), to advance this work across the nation.

Research Highlights

Understanding and preventing arsenic toxicity

A child pumps low-arsenic water at a newly installed deep well in Bangladesh. (Photo courtesy of Columbia SRC)

A study in Maine by Columbia SRC researchers was the first in the U.S. to show an association between arsenic in drinking water and decreased intellectual function. Columbia SRC researchers found that children with higher levels of arsenic in their water scored lower on intelligence tests, as compared to children with lower levels of arsenic.[1] About 45 million people in the U.S. rely on private wells for drinking water.[2] This study builds upon 15 years of Columbia SRC arsenic research in the U.S. and abroad.

In Bangladesh, researchers are studying more than 24,000 people exposed to arsenic in drinking water. Columbia SRC researchers have documented associations between arsenic exposure and skin lesions, cardiovascular and lung diseases, and lower IQ scores.[3,4]

Exploring ways to minimize health effects, Mary Gamble, Ph.D., demonstrated that folic acid supplements may help lower blood arsenic concentrations, and potentially help prevent arsenic toxicity.[5] Her team is also exploring the possibility that other supplements or nutrients may have similar effects.

Enhanced cleanup methods for groundwater arsenic at U.S. Superfund sites

Benjamin Bostick, Ph.D., and Steven Chillrud, Ph.D., are finding ways to improve the cleanup of arsenic from contaminated aquifers at Superfund sites. Their studies suggest that a single injection of safe, inexpensive compounds into groundwater could form a barrier to trap dissolved arsenic for 10-20 years, greatly reducing the threat of groundwater contamination.[6] Columbia SRC continues to use lab and field experiments to increase the efficiency of their strategy to immobilize arsenic in aquifers and to better understand its long-term use. This approach is one of several in the U.S. and overseas that focus on reducing exposures by lowering arsenic concentrations at the source.

Columbia SRC hypothesizes that magnetite (the black mineral) formed in aquifer sediments could immobilize dissolved arsenic in contaminated aquifers. (Photo courtesy of Columbia SRC)

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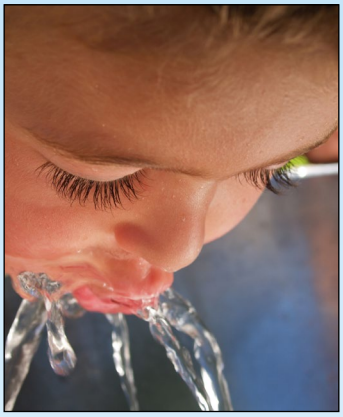

Columbia SRC forms interdisciplinary teams of biomedical and geoscience researchers to pinpoint exposure sources, exposure routes, and changes in populations that contribute to arsenic and manganese exposure risks. They are developing and implementing strategies to minimize exposures and reduce health risks using cost-effective approaches to solve environmental health problems.

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Encouraging use of low-arsenic wells to reduce exposure

Alexander van Geen, Ph.D., and his Columbia SRC team reported that a large proportion of wells in Bangladesh with high levels of arsenic that were labeled unsafe are still being used for drinking and cooking. Out of more than 10,000 wells, 19 percent were labeled as having high arsenic concentrations, and two out of three of those wells were still being used by villagers. The status of half of the wells was not known.[7] Van Geen and colleagues are working to find ways to build and test more wells, and implement programs to label wells more effectively. They are also developing educational programs to persuade people to use wells known to be safe.

The importance of studying arsenic and manganese contamination

- Arsenic and manganese contamination in groundwater and soil leads to major public health, cleanup, and environmental policy problems in the U.S. and abroad.
- Nearly 200 million people in the world are chronically exposed to arsenic in drinking water and diet. Arsenic is associated with several types of cancer, as well as cardiovascular, lung, and other diseases.[8]

Research overview

- Studying chronic health effects of low-level arsenic exposure over time. (Habibul Ahsan, M.D., habib@uchicago.edu)
- Investigating how children's health is affected by exposure to arsenic and manganese in drinking water. (Joseph Graziano, Ph.D., jp24@columbia.edu)
- Determining how nutrition can change or prevent the effects of arsenic in the body. (Mary Gamble, Ph.D., mvg7@columbia.edu)
- Understanding the processes that threaten the quality of groundwater in aquifers, and ways to lower exposure to arsenic from aquifers. (Alexander van Geen, Ph.D., avangeen@ldeo.columbia.edu)
- Investigating how arsenic, manganese, iron, and sulfur move through groundwater and sediment. (Benjamin Bostick, Ph.D., bostick@ldeo.columbia.edu)
- Identifying and testing new ways to increase the speed and efficiency of treatments used to remove arsenic from groundwater. (Steven Chillrud, Ph.D., chilli@ldeo.columbia.edu)

Sharing results

- Columbia SRC promotes arsenic testing and treatment to reduce health risks in people that rely on wells for drinking water. (Yan Zheng, Ph.D., yzheng@ldeo.columbia.edu)
- Columbia SRC created an interactive geographical information system map that allows users to visualize critical data about environmental contaminants and other information about areas near Superfund sites.[9] (Steven Chillrud, Ph.D., chilli@ldeo.columbia.edu)

Other contributions to advance science

The Columbia SRC research support facility provides vital access to expertise, research resources, and state-of-the-art instrumentation for its research projects. (Alexander van Geen, Ph.D., avangeen@ldeo.columbia.edu; Diane Levy, Ph.D., dl2015@columbia.edu; Joseph Graziano, Ph.D., jp24@columbia.edu; Peter Schlosser, Ph.D., schlosser@ldeo.columbia.edu)

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For more information on the National Institute of Environmental Health Sciences, visit **www.niehs.nih.gov**.

For more information on the Superfund Research Program, visit **www.niehs.nih.gov/srp**.

For more information on the Columbia University Superfund Research Center, visit **http://superfund.ciesin.columbia.edu**.

[1] Wasserman G, Liu X, Loiacono N, Kline J, Factor-Litvak P, van Geen A, Mey J, Levy D, Abramson R, Schwartz A, Graziano J. 2014. A cross-sectional study of well water arsenic and child IQ in Maine schoolchildren. Environ Health 13(1):23.

[2] USGS (U.S. Geological Survey). 2014. USGS Water Science School: Domestic Water Use. Available: http://water.usgs.gov/edu/wudo.html [accessed 1 June 2015].

[3] Chen Y, Parvez F, Gamble M, Islam T, Ahmed A, Argos M, Graziano J, Ahsan H. 2009. Arsenic exposure at low-to-moderate levels and skin lesions, arsenic metabolism, neurological functions, and biomarkers for respiratory and cardiovascular diseases: review of recent findings from the Health Effects of Arsenic Longitudinal Study (HEALS) in Bangladesh. Toxicol Appl Pharmacol 239(2):184-192.

[4] Wasserman G, Liu X, Parvez F, Ahsan H, Factor-Litvak P, van Geen A, Slavkovich V, Lolacono N, Cheng Z, Hussain I, Momotaj H, Graziano J. 2004. Water arsenic exposure and children's intellectual function in Araihazar, Bangladesh. Environ Health Perspect 112(13):1329-1333.

[5] Gamble M, Liu X, Slavkovich V, Pilsner R, Ilievski V, Factor-Litvak P, Levy D, Alam S, Islam M, Parvez F, Ashan H, Graziano J. 2007. Folic acid supplementation lowers blood arsenic. Am J Clin Nutr 86:1202-1209.

[6] Jing S, Chillrud S, Mailloux BJ, Bostick B. 2014. Arsenic In-Situ Immobilization by Magnetite Formation within Contaminated Aquifer Sediments. Available: http://superfund.ciesin.columbia.edu/sfund_files/documents/events/SRP2013_JingSunFirstPlacePoster.pdf [accessed 1 June 2015].

[7] Van Geen A, Ahmed EB, Pitcher L, Mey JL, Ahsan H, Graziano JH, Ahmed KM. 2014. Comparison of two blanket surveys of arsenic in tubewells conducted 12 years apart in a 25 km sq. area of Bangladesh. Sci Total Environ 488-489:484-492.

[8] Naujokas M, Anderson B, Ahsan H, Aposhian H, Graziano J, Thompson C, Suk W. 2013. The broad scope of health effects from chronic arsenic exposure: update on a worldwide public health problem. Environ Health Perspect 121(3):295–302.

[9] Columbia University Superfund Research Program Online Mapping Project — NPL Superfund Footprint: Site, Population, and Environmental Characteristics. http://superfund.ciesin.columbia.edu/sfmapper/map_intro.htm [accessed 1 June, 2015].